REMARKS

Single Means Rejection

We have addressed the Examiner's single means rejection by amending claims 1 and 7 to include a buffer underrun determination circuit. We submit, therefore, that this rejection should be withdrawn.

Claim Rejection under 35 USC 112 first paragraph

The Examiner rejected claims 1-9 arguing that the claimed circuit should include an element to detect or recognize the low power level condition. As described on page 9, line 33 to page 10, line 12 of the specification, the power level of laser is varied in accordance with the recording data output from the encoder 14. A recording operation is performed by repeatedly irradiating high power/low power laser to a disc, and the power level is indirectly recognized based on the recording data. The low power level condition is not an abnormal state. We submit that there should be no requirement for including an element to detect the low power level condition.

Claim Rejection under 35 USC 102

The Examiner rejected claims 1-5 and 7-9 as anticipated by or otherwise unpatentable in view of Yamasaki. In the alternative, the Examiner also rejects the claims 1-5 and 7-9 as unpatentable over Yamasaki in view of Yoshikawa.

We submit however that neither Yamasaki nor Yoshikawa, separately or in combination, describe or suggest that data recording is interrupted when the laser is generated at a low recording level, even in a state that a buffer under run error may occur.

The present invention has a specific feature that data recording is interrupted when the laser is generated at a low recording level, even in an undesirable state such as when a buffer underrun error occurs. More particularly, if a buffer under run error is likely to occur, the control circuit continues data recording and waits until the laser power becomes a low recording level, and then, data recording is interrupted. When the laser records at the low recording level

recording pits are not formed. Among other advantages, the data that has already been recorded is not destroyed even if data recording is restarted at a location that is offset from where it should be (see page 19, lines 7-24 of the specification). In addition, even if the restart timing is delayed, the continuity of the recording pit at the restart position is ensured, because the restart location is in an area where the laser at a high recording level is not irradiated. Since the recorded data is not erroneously overwritten by the restart recording operation, the invention recited in the claims is particularly advantageous for use for a write-once optical disc recorder, such as a CD-R drive.

Yamasaki patent (US. 5,521,893) discloses a optical magnetic disc recorder including a laser power control circuit 8 and abnormality detection circuits 7, 9. As described in col. 3, lines 9-33, when the abnormality detection circuit 7 or 9 detects any abnormality, such as tracking jumping, off-tracking, defocusing or excess power of laser beam, the abnormality detection circuit outputs an error signal FLT to the laser power control circuit 8. Upon receiving the error signal FLT, the laser power control circuit 8 immediately switches the amount of light beam to the value required during reproducing (col. 3, line 29). Accordingly, the optical magnetic disc recorder does not wait until the laser power level goes a low recording level and does not interrupt data recording when the laser is generated at a low recording level.

Further, the Yamasaki patent does not relate to a technique for preventing occurrence of a buffer underrun error, because abnormality of the Yamasaki patent includes tracking jumping, off-tracking, defocusing, and excess power of light beam but it does not include a buffer underrun error. The disc recorder of the Yamasaki patent executes erasing and re-writing, as soon as a writing error is detected in order to reduce a retry time and an access time during a write operation (see col. 6, lines 51-55 and col. 7, lines 34-38). Therefore, the functions and the advantages of the Yamasaki patent are different from those of the present invention. Lastly, the disc recorder of the Yamasaki patent would not provide the same advantages discussed above in relation to use with a write-once optical disc such as a CDR, because an erasing operation is required.

Yoshikawa patent (US. 4,858,219) discloses a data recorder including a controller 9 for maintaining the power level of laser flux within a predetermined range based on the difference between a detected light beam intensity and a predetermined reference power level (col. 3, lines 44-54 and claim 1). The Yoshikawa patent does not relate to the technique for preventing

occurrence of a buffer underrun error. There is no suggestion that the data recorder waits until the laser power level goes a low recording level and interrupts data recording when the laser is generated at a low recording level.

As described above, the Yamasaki patent and the Yoshikawa patent are quite different from the present invention. Since the cited patents do not relate the technique for preventing occurrence of a buffer underrun error, there is no motivation to combine the cited patents to solve the buffer underrun error problem. And, even if the cited patents are combined, a person with an ordinary skill in the art cannot achieve the present invention. A person with an ordinary skill in the art would consider that data recording should be interrupted as far in advance, as possible before a buffer memory becomes empty.

Claim Rejection under 35 USC 103

As to item 4, the Examiner mistakes a relatively low power level for an abnormal operating condition. As described on page 15, lines 4-21 and page 20, line 28 to page 21, line 6 of the specification, the low power level laser corresponds to low level recording data, such as synch pattern data. Therefore, the low power level is not an abnormal condition.

JPlO-63433, which is equivalent to US. 5,815,472 of Kuroda, discloses interrupting data recording in accordance with a storage amount of temporarily stored information in a buffer memory. However, a part of data is overwritten and is destroyed by a re-recording operation of Kuroda (see col. 14 line 61 to col. 15, line 5 of the Kuroda patent). The Kuroda patent does not teach avoiding overwriting and destruction of recorded data, which is one of the technical ideas of the present invention. Accordingly, the interruption of the Kuroda patent is different from that of the present invention. Further, the Kuroda patent does not suggest of laser power level when the recording interruption occurred. Koishi patent (US. 4,800,548) discloses a recording apparatus that includes a write protecting means for changing the laser power from a recording state to a non-recording state when a writing error such as truck jumping is detected during a recording operation. When a writing error is occurred, the write protecting means immediately lowers the laser power without regard to the level of the recording data. Therefore, the function of the write protecting means is different from the interruption/restart circuit 43 of the present invention.

Koishi patent (US. 4,546,462) only discloses a recording apparatus having a inspecting means for detecting a presence of a dropout on an optical recording disc. When a sector having a dropout is detected, the recording apparatus records data by skipping the sector. There is no suggestion that data recording is interrupted when the laser is generated at a low recording level.

Takasugi patent (US. 4,507,767) discloses a disc device that prevents a error resulting from excess power of laser in a reading operation. Overwriting on data that has been recorded is prevented by an abnormality detecting circuit 6 and a protecting means 5. However, the functions of the abnormality detecting circuit 6 and the protecting means 6 are different from the interruption/restart circuit 43 of the present invention.

As described, none of the cited references disclose/the specific feature of the present invention that data recording is interrupted when a buffer under run error may occur and when the laser is generated at a low recording level. Even if the cited references are combined, the present invention having the specific feature is not achieved.

Double Patent Rejection

The 09/717,771 application is directed to a data recorder that continues a recording operation until the laser power becomes a low level, even when a buffer under run error may occur. On the other hand, the 09/717,772 application is directed to a data recorder that activates a laser before restarting data recording so that the laser power at the restart position is high enough to record data. We submit that in view of the amendments to the claims, the subject matter sought to be prosecuted by the two applications are very different, and that the provisional double patenting rejection should be withdrawn. We also submit that because the Examiner considered a relatively low power level to be a system failure (page 5, lines 7-9 and page 8, lines 1-2 in the Office Action), he may have believed the subject matter to be more similar than they were.

Attached is a marked-up version of the changes being made by the current amendment.

Applicant asks that all claims be allowed. Enclosed is a Petition for Three Months Extension of Time and a check for the required fee of $920. Also enclosed is a Request for Continued Examination with the required fee of $740. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: December 6, 2002

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Version with markings to show changes made

In the claims:

Please cancel claim 6 without prejudice.

Please amend claims 1-4 and 7-9 as follows:

1. (Twice Amended) A control circuit for a data recorder, wherein the data recorder records data on a recording data by emitting a laser beam against a recording medium and has a buffer memory for temporarily storing data, an encoder for encoding the data of the buffer memory into the recording data, and a laser drive circuit for controlling the power level of the laser beam in accordance with the level of the recording data, wherein the data recorder generates the laser beam at a relatively high power level sufficient to form a recording pit on a recording layer of the recording medium when the level of the recording data is high, and the data recorder generates the laser beam at a relatively low power level insufficient to form a recording pit on the recording layer of the recording medium when the level of the recording data is low, the control circuit comprising:

a laser drive circuit for controlling the power level of the laser beam;

a buffer underrun determination circuit for determining whether or not the buffer memory is in a state in which buffer underrun may occur based on the amount of data stored in the buffer memory, and

an interrupt control circuit connected to the laser drive circuit, for interrupting data recording when [a predetermined state is detected, wherein the interruption occurs] the buffer underrun determination circuit determines that buffer underrun may occur and when the laser beam is generated at [a] the relatively low power level.

2. (Amended) The control circuit according to claim 1, wherein the data includes synch pattern data, the power level of the laser beam corresponding to the synch pattern data is the relatively low power level, and the interrupt control circuit interrupts data recording when the laser beam is generated at the relatively low power level in accordance with the synch pattern data.

3. (Twice Amended) A controller employed in a data recorder to control interruption and restart of recording data, wherein the data recorder records on a recording medium data stored in a buffer memory by emitting a laser beam against the recording medium, the laser beam being generated at a high level and a low level, wherein the laser beam at the relatively high power level forms a recording pit on a recording layer of the recording medium and the laser beam at relatively low level does not form a recording pit on the recording layer of the recording medium, the controller comprising:

a buffer underrun determination circuit for determining whether or not the buffer memory is in a state in which buffer underrun may occur based on the amount of data stored in the buffer memory;

an address memory for storing at least one of an address of the recording medium and an address of the buffer memory when data recording on the recording medium is interrupted, each address indicating a location of data when the recording interruption occurred;

a synchronizing circuit for sequentially reading the data recorded on the recording medium prior to the recording interruption and the data stored in the buffer memory prior to the recording interruption and synchronizing the recorded data and the stored data;

a restart circuit for restarting data recording on the recording medium based on the address stored in the address memory and;

an interrupt control circuit for interrupting data recording when [a predetermined state is detected] the buffer underrun determination circuit determines that the amount of data in the buffer memory may become null and cause the buffer memory to become empty and the laser beam is generated at a relatively low power level.

4. (Amended) The controller according to claim 3, wherein the data includes synch pattern data, the power level of the laser beam corresponding to the synch pattern data is the relatively low power level, and the interrupt control circuit interrupts data recording when the laser beam is generated at the relatively low power level in accordance with the synch pattern data.

7. (Twice Amended) A controller for a data recorder, wherein the data recorder records data on a recording medium by emitting a laser beam against the recording medium, wherein the data is formed by a plurality of sectors, each of the sectors including a synch pattern that has a predetermined number of bits representing a low level, the controller comprising:

a buffer underrun determination circuit for determining whether or not the buffer memory is in a state in which buffer underrun may occur based on the amount of data stored in the buffer memory;

a laser drive circuit, which controls the power level of the laser beam, wherein the laser beam is generated at a low power level in accordance with the low level of the synch pattern; and

an interrupt control circuit for continuing recording until an interval between sectors appears when [detecting a predetermined state] the buffer memory is in a state in which buffer underrun may occur and interrupting the recording operation when the laser beam is generated at the low power level in accordance in with the synch pattern of a sector.

8. (Twice Amended) A method for interrupting data recording in a data recorder to prevent the occurrence of a buffer underrun error, wherein the data recorder records data on a recording medium by emitting a laser beam against the recording medium, and the data is formed by a plurality of sectors, each of the sectors including a synch pattern that has a predetermined number of bits representing a low level, wherein the laser beam is generated at a low power level in accordance with the low level of the synch pattern, the method comprising:

determining whether or not a buffer memory of the data recorder is in a state in which buffer underrun may occur based on the amount of data stored in the buffer memory;

continuing recording until an interval between sectors appears when a predetermined state is detected; and

interrupting the recording operation when the buffer memory is in a state in which buffer underrun may occur and the laser beam is generated at the low power level in accordance with the synch pattern of a sector.

9. (Amended) A method for interrupting and restarting data recording in a data recorder to prevent the occurrence of a buffer underrun error, wherein the data recorder records

on a recording medium data stored in a buffer memory by emitting a laser beam against the recording medium, the method comprising:

determining whether or not the buffer memory is in a state in which buffer underrun may occur based on the amount of data stored in the buffer memory;

interrupting data recording when [a predetermined state is detected] the buffer memory is in a state in which buffer underrun may occur;

storing in an address memory at least one of an address of the recording medium and an address of the buffer memory when data recording on the recording medium is interrupted, each address indicating a location of data when the recording interruption occurred;

sequentially reading the data recorded on the recording medium prior to the recording interruption and the data stored in the buffer memory prior to the recording interruption;

synchronizing the recorded data and the stored data; and

restarting data recording on the recording medium based on the address stored in the address memory, wherein the interrupting of the data recording is performed when the laser beam is generated at a relatively power level.